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(54) FLAT ENVELOPE TYPE FLUORESCENT CHARACTER-INDICATING TUBE

(71) We, TOKYO SHIBAURA ELECTRIC COMPANY LIMITED, a Japanese Company of 72, Horikawa-cho, Saiwan-ku, Kawasaki-shi, Kanagawa-ken, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a flat envelope type fluorescent character-indicating tube having a plurality of character-indicating elements arranged in an evacuated envelope. The characters formed by the elements may be digits or letters.

Of the many types of fluorescent character-indicating tubes at present available, one is of the flat envelope type, comprising a substantially planar insulating base and a flat envelope cover sealed to the base. Such an arrangement enables a compact tube to be obtained, relative to the more usual elongate circular envelope type tube.

The invention particularly relates to a flat envelope fluorescent character-indicating tube comprising: an evacuated envelope formed by an envelope cover having a transparent conductive film on at least a part of its inner surface, and a base plate sealed to the cover; a plurality of character-indicating elements arranged lengthwise of the base plate, each such element comprising a plurality of anode segments selectable for different characters, and a control grid for selecting the element; at least one thermimic emission filament extending lengthwise of the envelope above the elements; and a getter support structure located adjacent one end of the envelope and supporting a getter source. Such a tube will be referred hereinafter as "of the type described".

Although the beforementioned compactness of a tube of the type described is advantageous, it has has certain technical problems. The first such problem relates to the deposited film of getter material on the inner surface of the envelope in order to maintain a required degree of vacuum in the tube. The getter material, which is usually barium, is evaporated from the getter source, by heating the source, as by an externally induced radio frequency current, and is deposited on the adjacent surface of the envelope cover. However, it has been found that the getter material is liable to be deposited on the character-indicating elements, thereby reducing the fluorescence and affecting the insulation between the various electric circuits. In addition, the getter material may be deposited on the surface of the envelope cover located above the elements, with resulting obscuring of at least the character-indicating element closest to the getter source.

A second problem has been the so-called end cooling effect of the cathode filament or filaments. The filament or each filament is stretched between a pair of support elements and, because of the conduction of heat from the filament to the support elements, the amount of electron-emission from nearer the support elements is less than that from the central parts of the filament. The reduction of electron emission at the ends of the filament reduces the brightness of the character-indicating elements located nearest those ends. To avoid that disadvantage, it has been necessary to support the ends of the filament at locations as far as possible away from the end character-indicating element; this, however, increases the length of the envelope and therefore the compactness of the tube.

The present invention resides in a flat envelope fluorescent character-indicating tube of the type described, in which the getter support structure has a shield plate extending towards the envelope cover and adapted to minimise migration of getter material towards the elements, and in which the filament or each filament is secured at one end to the getter support structure at a location spaced from the shield plate in the direction of the adjacent envelope end.

Thus, the presence of the shield plate at least mitigates the first of the disadvantages referred to above. As to the second dis-

advantage, the securement of the filament at a location distant from the shield plate enables the end cooling effect of the filament to be limited to that part of the filament on the side of the shield plate distant from the character-indicating elements; thus, there is no material reduction in emission of the filament over the character-indicating elements, and therefore little reduction in the brightness of the elements.

The shield plate may be carried by the getter support structure and may be in fact integral with that structure. Preferably, the shield plate or the getter support structure includes a resilient connector member which contacts the transparent conductive film coated on the inner surface of the envelope cover, and acts as the shielding connection for that film.

The invention will be more readily understood by way of example from the following description of various forms of character-indicating tubes in accordance therewith, reference being made to the accompanying drawings, in which:—

Figure 1 is a perspective view of the tube envelope, the envelope cover being broken away to show the interior;

Figure 2 is a perspective view of the getter support structure and shield plate shown in Figure 1;

Figure 3 is an exploded view of the structure of Figure 2;

Figure 4 shows a structure similar to that of Figures 2 and 3, but including a resilient connector;

Figure 5 and 6 show modifications, in which the resilient connector is formed as part of the shield plate; and

Figure 7 is a perspective view of a simplified form of getter support structure and shield plate.

The character-indicating tube of Figure 1 has a sealed envelope formed by a flat envelope cover 10, which includes a transparent viewing window 11 and which is sealed to an electrically insulating base plate 12. The base plate 12 is made of glass or ceramic or the like, and the envelope cover 10 is preferably made of glass. A number of electric circuits are printed on the base plate 12. After appropriately applying a thin insulating layer over the electric circuits, a number of character-indicating elements spaced along the length of the envelope are formed on the base plate. Thus, each element contains a number of independent anode segments disposed in a known predetermined form, and printed on to the base plate. The elements have identical anode segments, and those segments in the corresponding positions in the elements are connected in common through the insulating layer to an individual printed circuit. Each anode segment is coated with a phosphor material, such as zinc oxide.

Each element further comprises a mesh control grid 14, which is disposed above the anode of the same element, and each control grid is connected to an individual terminal 16 which passes between the base 12 and cover 10. The corresponding anode segments of the various elements are connected to an individual terminal 18, which passes through the envelope in similar manner.

The envelope further encloses at least one directly heated filament or cathode. Thus, Figure 1 shows two such filaments 20 disposed lengthwise of the envelope and above the control grids 14, each being secured at one end to a resilient anchor 24 extending from a support member 22 and, at the other end, to a getter support structure, shown generally at 26. The support member 22, located adjacent one end of the base plate 12, is electrically connected to a terminal 28 passing through the envelope. The member 22 carries a spring connector 30, which electrically contacts a transparent conductive film, such as SnO_2, which is coated on at least the inner surface of the viewing window 11, and which is connected through the connector 30, the support member 22 and the terminal 28 to an electric shielding potential. Each filament 20 is attached to the anchor 24 and the getter support structure 26 by electric welding or the like.

In each character-indicating element, the character segments can be selectively caused to luminesce to form any of a number of different characters, such as the numerals from 0 to 9. Selection is effected by energising the terminals connected to the required segments, and the terminal connected to the control grid 14 of the selected element.

The getter support structure 26 of Figure 1 will now be explained with reference to Figures 2 and 3.

It is well known to employ a getter in a tube envelope, in order to maintain a required degree of vacuum. The getter material, usually barium, is deposited on the inner surface of the cover 10, by heating a getter source, as by passing an externally applied radio frequency current through the source. As illustrated in Figures 2 and 3, the source is in the form of a non-magnetic stainless steel ring 32 of U-shape section, the groove of which is filled with getter material. In order to localise the deposition of the getter material to that part of the cover 10 immediately over the getter support structure 26, that structure carries a shield plate 36 which extends upwardly towards the cover.

The getter support structure 26 is a metal stamping, formed up to have a base 37,

from which extends two L-shaped sides 38, a vertical plate 39, which extends upwardly from the edge of the base 37 closest to the adjacent character-indicating element and which is disposed centrally between the sides 38, and a filament support member 40 extending upwardly from the edge of the base 37 more distant from the character-indicating elements. The getter support structure 26 is seated on a conductor 42, in electrical contact therewith.

The shield plate is U-shaped in plan and is part of a second metal stamping, which is formed up to have a horizontal platform 43 having two cut-outs forming between them a finger 34. Finger 34 is bent round the ring 32, as illustrated in Figure 2, and is secured to the ring, as by electric welding. The shield plate 36 is secured to the support structure 26, the platform 43 being seated on the horizontal edges of the L-shaped sides 38, i.e. as shown in Figure 2. When so mounted, the shield plate 36 extends closely to the inner face of the cover 10 and prevents the migration of getter material towards the character-indicating elements, the nearest of which is closely adjacent the shield plate.

The filaments 20 pass below the shield plate 36 and through the spaces between the plate 39 and the sides 38. The filaments thus extend beyond the shield plate 36 and their ends are secured, as shown, to the filament support member 40 which is at some distance from the character-indicating elements. In that way, the end cooling effect is limited to those parts of the filament between the shield plate 36 and the support member 40, with the result that full emission is obtained from the length of the filaments over the character-indicating elements.

Figure 4 shows the addition of a resilient connector 31 mounted on the getter support structure 26. In the particular arrangement illustrated, the connector 31 is secured to one of the L-shaped sides 38. The connector 31 contacts the transparent conductive layer on the cover 10 and supplements, or replaces, the connector 30 (Figure 1).

Figures 5 and 6 illustrate embodiments in which the shield plate 36 is formed with an integral resilient connector 33, performing the function of the connector 30 of Figure 1 and the connector 31 of Figure 4. In Figure 5, the connector 33 takes the form of a central, integral, tongue extending out of the wall of the shield plate 36. In Figure 6, the connector 33 is formed as a resilient, upward, extension of the end wall of the shield plate 36. In both the embodiments, the connector 33 also functions to shield or restrict the migration of the getter material.

In the embodiments of Figures 2 to 5, the shield plate 36 has been made independently of the support structure 26. Figures 6 and 7, however, show integral constructions formed out of single stampings. Figure 7 differs from Figure 6, in the omission of the integral connector 33, connection to the transparent conducting film being performed by a connector at the other end of the tube, as illustrated at 30 in Figure 1.

By the constructions described and illustrated in the drawings, it is possible to limit the deposition of the evaporated getter to the area of the envelope cover above the getter support structure. Also, as the end of each filament is secured at a location beyond the shield plate, it is possible to ensure equal brightness of all the character-indicating elements, while at the same time having a compact envelope. Lastly, the arrangements illustrated provide a simple construction of the getter support structure an dthe shield plate.

WHAT WE CLAIM IS:—

1. A flat envelope fluorescent character-indicating tube of the type described, in which the getter support structure has a shield plate extending towards the envelope cover and adapted to minimise migration of getter material towards the elements, and in which the filament or each filament is secured at one end to the getter support structure at a location spaced from the shield plate in the direction of the adjacent envelope end.

2. A character-indicating tube according to claim 1, in which the shield plate is carried by the getter support structure.

3. A character-indicating tube according to claim 2, in which the shield plate and getter support structure are integral.

4. A character-indicating tube according to claim 2 or claim 3, in which the shield plate is U-shaped in plan.

5. A character-indicating tube according to any one of the preceding claims, in which the shield plate or the getter support structure includes a resilient connector member contacting the transparent conductive film coated on the inner surface of the envelope cover.

6. A character-indicating tube according to any one of claims 1 to 4, in which the shield plate has a resilient shielding portion contacting the transparent conductive film coated on the inner surface of the envelope cover.

7. A character-indicating tube according to any one of the preceding claims, in which the getter support structure comprises a base having at the end adjacent the elements an

upstanding member supporting the shield plate and at the other end an upstanding integral rib to which the end of the filament or of each filament is secured.

8. A flat envelope type fluorescent character indicating tube, substantially as herein described with reference to Figures 1 to 3 or as modified as described with reference to any of Figures 4 to 7.

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1481944 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

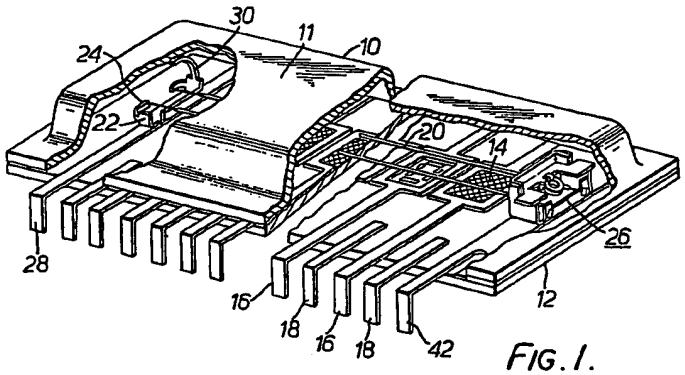

FIG. 1.

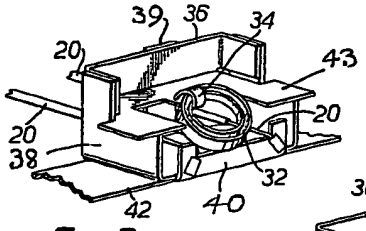

FIG. 2.

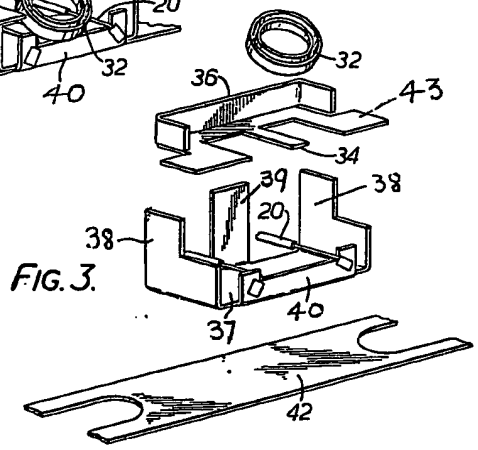

FIG. 3.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

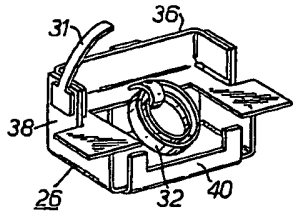

FIG.4.

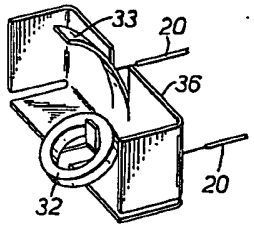

FIG.5.

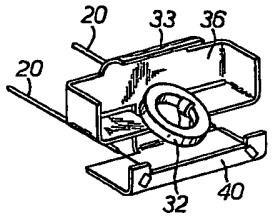

FIG.6.

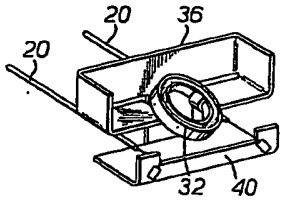

FIG.7.